

ILLUMINATION DEVICE FOR VEHICLES

[0001] This nonprovisional application is a continuation of International Application No. PCT/EP2019/082386, which was filed on Nov. 25, 2019 and which claims priority to German Patent Application No. 10 2018 130 512.5, which was filed in Germany on Nov. 30, 2018 and which are both herein incorporated by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

[0002] The present invention relates to an illumination device for vehicles, comprising a first light module having a light source and an optical unit for generating a first illumination region, comprising a second light module having a light source and an optical unit for generating a second illumination region, comprising a control unit for controlling the first light module and the second light module, so that a larger number of light pixels are imaged in the first illumination region than in the second illumination region with respect to a surface of equal size.

Description of the Background Art

[0003] An illumination device for vehicles is known from DE 10 2005 041 234 A1, which corresponds to US 2008/0239746, which is incorporated herein by reference, and which comprises a first light module and a second light module. Both light modules have a similar light source, each of which is designed as a matrix of LED light sources. The optical units of the two light modules are designed differently so that light pixels of different sizes can be generated in a light distribution. The smaller light pixels can be used to better reproduce, for example, the asymmetrical rise of a light/dark boundary. Because the one light module has a higher resolution, i.e., the neighboring light pixels are imaged at a smaller beam angle, a plurality of light distributions can be designed to be more homogeneous. The control of the individual lighting elements of the light source, therefore, the activation of the lighting elements at full load or at partial load when dimming, depends on the local light intensity requirement within the light distribution.

[0004] An illumination device for vehicles with a first light module and a second light module is known from DE 10 2016 216 364 A1, which corresponds to US 2018/0056850, with each module comprising a light source and an optical unit. The illumination device further has a control unit, so that the second light module emits light substantially into a second illumination region in an area in front of a vehicle, the second region being substantially contained within a first illumination region illuminated by the first light module. The second light module emits light of a lower resolution and higher light luminance than the first light module. The second light module can be used to increase a range. Thus, when the first light module and the second light module are activated, a high beam distribution can be generated in particular. To generate the relatively broad second illumination region, the second light module has a matrix-like arrangement of a plurality of light source elements, preferably LED light elements, as the light source. The optical unit of the first light module can be formed, for example, by a micromirror array (DMD). The light source of the second light module is designed as a single, high-intensity light source, for example, as an LED light source

or laser light source. The superposition of light modules of a different resolution and light intensity enables the provision of a variety of different light distributions. However, it is desirable to optimize the illumination device in such a way that the cooling effort is as low as possible.

SUMMARY OF THE INVENTION

[0005] It is therefore an object of the present invention to develop further an illumination device for vehicles in such a way that a plurality of light modules with a different resolution and different light intensity are controlled coordinated with one another, so that a large number of different light distributions can be generated with a minimal cooling effort.

[0006] To achieve said object, the invention 1 is characterized in that the light pixels of the first light module have a greater illumination intensity than the light pixels of the second light module, and in that the control unit acts upon the light sources of the first light module or the second light module in such a way that when the light sources are activated, said light sources of the first and second light modules are each operated with a thermal output within a tolerance band and below a maximum thermal output of the at least one light source, whose upper output value corresponds 70%, preferably 65%, in particular 55%, to the maximum light output of the first light module or second light module.

[0007] The advantage of the invention is that a plurality of different and in each case homogeneous light distributions can be generated with a reduced cooling requirement. The basic idea of the invention is to control the light modules so that a predefined number of different light distributions are generated with an optimal, preferably uniform distribution of the light output between the light modules. Two requirements are fulfilled hereby. On the one hand, the light modules are controlled so that the superimposed light pixels of the light modules in the light distribution fulfill the lighting specifications. On the other hand, the light modules are controlled such that the light output is uniformly distributed between the light modules.

[0008] A tolerance band for the light output with which the light sources of the respective light modules are operated can lie in a range of 50% of the maximum light output of the light source with the highest light intensity. The cooling requirement for the respective light sources can thus be reduced, because all light source elements of the respective light source are operated within the arithmetic mean with an electrical power within the tolerance band. This does not preclude individual light source elements from being operated at maximum output. A compensation is created in that other light source elements are in the switched-off state or are only slightly dimmed with a relatively low light output. The basic inventive idea here is not to operate all light source elements of a light source at full output but only a part of them, so that the light source can be operated overall with an electrical power significantly below the maximum output or the nominal output. This can reduce the cooling requirement. A compensation for the loss of light output takes place by a corresponding control of another light source.

[0009] The tolerance band can be in the range from 35% to 65%, in particular from 45% to 55%, preferably from 48% to 52% of the maximum light output of the light source. The maximum light output of the light source is determined by the sum of the maximum light output or nominal output of